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ABSTRACT

In 1991, International Business Machines (IBM) Corporation announced its commitment to work with higher education to accelerate the teaching, research, and use of quality management practices in college and university operations. Besides cash and equipment awards being offered, IBM proposed partnerships with IBM facilities to include loaned executives, IBM speakers, and faculty and student internships with IBM. This report, in five sections, examines the initial activities and future plans of nine Partnership institutions: (1) Clark Atlanta University (Georgia); (2) Southern College of Technology (Georgia); (3) Georgia Institute of Technology; (4) Oregon State University; (5) Pennsylvania State University; (6) Rochester Institute of Technology (New York); (7) University of Houston at Clear Lake (Texas); (8) University of Maryland at College Park; and (9) the University of Wisconsin at Madison. The first section establishes the context for pursuing a quality management agenda on college campuses. Remaining sections synthesize the quality efforts and plans of the institutions across the four major criteria used to evaluate proposals: embedding quality management principles into core business and engineering courses; conducting research on issues related to quality management; using quality management to improve university operations; and sharing the knowledge gained through the Partnership with others. In addition, the report contains profiles of each institution highlighting a distinctive characteristic of its proposal. An appendix details the competition guidelines and selection process. (GLR)

ED 363 170

The IBM - TQM Partnership With Colleges and Universities

A Report

HE026 777

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The IBM - TQM Partnership With Colleges and Universities

A Report

A baseline report of the initial activities and future plans of the nine Partnership institutions.

About the Author

Daniel Seymour is the president of QSystems (a Palm Springs, California, quality management consulting firm) and a visiting scholar at Claremont Graduate School. Dr. Seymour has written numerous articles and conducted research studies on the role of TQM in service industries, and he participates actively in the American Society for Quality Control (ASQC) and in the Academic Quality Consortium (a collaboration of the American Association for Higher Education and the William C. Norris Institute). His 1992 American Council on Education book, *On Q: Causing Quality in Higher Education*, is in its third printing.

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The IBM - TQM Partners

Clark Atlanta University/Southern College of Technology

Georgia Institute of Technology

Oregon State University

Pennsylvania State University

Rochester Institute of Technology

University of Houston-Clear Lake

University of Maryland-College Park

University of Wisconsin-Madison

Introduction

In October 1991, IBM announced that it would make a significant commitment to work with higher education to accelerate the teaching, research, and use of quality management practices in college and university operations. Its commitment? Eight cash and equipment awards — $1 million in cash or $3 million in IBM equipment, or a combination thereof, to each institution over five years. Awarded institutions also were offered partnerships with IBM facilities that included loaned executive(s), IBM speakers, and faculty and student internships with IBM.

IBM provided the stimulus, and the response was overwhelming. By the competition deadline in May 1992, some 2,000 copies of the competition's guidelines had been distributed and more than 200 proposals had been received. An assessment of those institutions that submitted proposals but did not receive awards showed that many were committed to pursuing their quality improvement plans. Indeed, three out of four indicated that they were moving forward with either some or most of the initiatives that were developed in their proposals.

This Report is intended to share with the higher education community the accomplishments and aspirations of the colleges and universities that did receive awards. Such sharing is a way to leverage IBM's commitment so that other higher education institutions might benefit from this unique industry/education collaboration.

The material in the Report is taken from two sources: the award recipients' proposals and an IBM-hosted Sharing Conference. The proposals are detailed documents; each contains, on average, fifty pages of materials that describe the institution's previous quality management efforts, as well as its proposed initiatives, across a wide array of educational activities. The Sharing Conference was held on the University of Maryland-College Park campus in February 1993. Its purpose was to facilitate information exchange among the nine IBM-TQM Partnership universities. (One of the eight awards was given to a joint proposal by Clark Atlanta University and the Southern College of Technology.)

This Report contains five sections: The Driving Needs; Curriculum Development; Research; Running the University; and Propagation and Sharing. The first section establishes context. It describes the motivation, as detailed by the administrators and principal investigators of the universities, for pursuing a quality management agenda on college campuses. The remaining sections synthesize the quality efforts and plans of the institutions across the four major criteria used to evaluate proposals: embedding quality management principles into core business and engineering courses; conducting research on issues related to quality management; using quality management to improve university operations; and sharing the knowledge gained through the Partnership with others.

In addition, the Report contains profiles of each institution highlighting a distinctive characteristic of its proposal. An Appendix details the competition guidelines and selection process.

I am grateful for the support of IBM and the American Association for Higher Education in this important work.

Daniel Seymour

IBM International Business Machines Corporation

Office of the Director, Market-Driven Quality Manufacturing & Development
Corporate Headquarters

Route 100, Somers, New York 10589

August 1993

IBM is pleased to have sponsored this competition and follow-on partnership to accelerate the implementation of total quality management in the teaching, research, and operations of colleges and universities. We believe that working together, the academic and business communities can help accelerate the use of total quality management not only in education and industry, but in our nation as a whole.

We are heartened by the overwhelming response to this competition. We are further encouraged by the response from approximately 2/3 of the 204 applicants that they intend to continue the necessary steps to implement total quality management. It is our sincere hope that this report helps these and other colleges and universities on their journey.

Howard D. Wilson
Director, Market-Driven Quality
Corporate Services - IBM

John C. Porter
Education & University
Relations - IBM

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Chapter 1 The Driving Needs

One of the most oft-repeated sayings among quality consultants is, "No one likes change, except a wet baby." From a pediatric perspective, this might be true. But from an organizational perspective, the saying stretches the truth. It isn't that people don't like change. What they don't like is the uncertainty that usually accompanies change. Most individuals understand that change is inevitable —"The only constant is change." They realize that today's environment is dominated by shifting relationships, dynamic technologies, and aggressive competition. They understand the need to stay current and develop increased flexibility and responsiveness. It isn't a matter of like or dislike; instead, it is a matter of reducing uncertainty by effectively managing change.

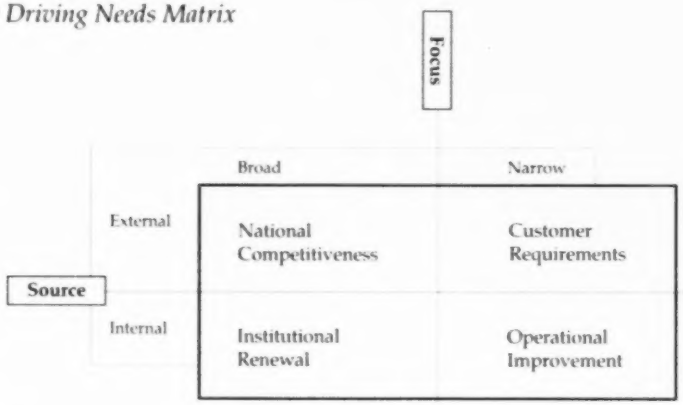
Two conditions are necessary to reduce uncertainty and facilitate change: one is motivation, the other means. Individuals must realize that their current position or way of operating is untenable in the long run. They must believe — not just be told — that their ability to thrive in a dynamic environment depends on their identifying new and better approaches to their work. And, they must develop the tools — the means — to effect change.

The IBM-TQM competition suggested that higher education consider the worthiness of Total Quality Management as a means to generate organizational transformation. The issue of motivation, however, was not directly addressed in the competition guidelines. IBM did not ask institutions to detail their rationales for undertaking the substantial task of proposal writing. Of course, the Partnership "prize" of cash and equipment was a significant motivator. But that prize was a necessary but insufficient stimulus to rethink such core functions as curriculum development, research, and operations. There also must have been a more fundamental set of motivators that made the pursuit of the prize a reasonable use of the institution's scarce time and resources.

Such driving needs emerged in the body of the proposals, in the accompanying letters from the institution presidents, and at the IBM Sharing Conference, during which the nine institutions discussed their current TQM activities and future initiatives.

An analysis of those embedded motivators results in the following schemata:

The Driving Needs Matrix



The vertical axis, *Source*, suggests that the Partnership institutions attributed their motivations to both the external environment or the environment within their institutions. *Focus*, the horizontal axis, suggests the driving needs were either broad, reflecting a comprehensive motivation, or narrow, with a more sharply defined need. The following sections describe the four resulting cells.

Improving Our National Competitiveness

The Partnership universities expressed a strong belief that one aspect of their institutional missions was to provide the human resources for this country's economic engine. The idea that institutions of higher education have a responsibility to graduate students who will be in the best possible position to contribute to the global competitiveness of our industries was articulated in the University of Maryland's proposal. One of its primary objectives was

> *"... to enhance the economic competitiveness of businesses in the region and nation by developing a 'new breed' of undergraduates with an instinctive orientation toward quality principles and a level of preparedness that facilitates immediate transfer of quality knowledge and practiced skills into the workplace."*

The universities discussed this need to enhance the economic competitiveness of businesses in a broad context that emphasized a supplier role. For example, a number of institutions expressed the importance of operationalizing their supplier role by working in partnership with industry. Rochester Institute of Technology suggested that higher education needed to form "a partnership with industry to recapture worldwide competitive advantage for the United States." The University of Houston-Clear Lake's associate vice president, Glenn Freedman, voiced a similar

theme at the IBM Sharing Conference: "I'll guarantee we wouldn't be standing here today if it weren't for the rest of the companies and the partners that we have in the Houston area." The evidence for such a statement was made explicit in UHCL's proposal:

> *"Recognizing the importance of research and technological development to the continued growth of the region, the University of Houston-Clear Lake has assumed a leadership role by molding its academic programs to fortify the economic development of the region."*

William Kirwan, University of Maryland's president, also addressed the partnership subject in his university's proposal, saying that he saw industry not only as a primary customer "... but also as a critical ally in preparing [students] to compete in a rapidly changing economic environment."

Total Quality Management, then, is seen as a way to enhance the effectiveness of higher education's role as a supplier of knowledge and learning resources to a nation whose industries find themselves engaged in an economic battle for survival.

Conforming to Customer Requirements

In addition to the general notion of economic competitiveness, there is a more narrowly focused external motivator that deals with conforming to customer requirements. In a TQM environment, those who use or benefit from the output of a process — that is, the customers — define "quality." Such a definition is important to higher education in that it can make institutions more responsive and more effective in the pursuit of their individual missions. It can help ground the institution and its members in the details of daily work.

The major customer group, of course, is industry. Its expectations include both that new hires will possess particular competencies and that the money required to further educate and train those hires will be minimal, that is, the unnecessary cost of rework when personnel do not have the requisite competencies. Several proposals addressed the issue of competencies. The Oregon State University proposal, for example, stated, "... we are hearing faculty members, students, and industry leaders such as IBM voice the conviction that knowledge of TQM concepts and experience with TQM tools are essential in today's competitive business world." Similarly, Rochester Institute of Technology's dean of the College of Business, Richard Rosette, said, "We have begun to realize that we were going to have to pay a lot of attention to what employers were telling us our students need to know."

The institutions also are well aware of the consequences of non-conformance. "The real bottom line of all of this is we're not going to be able in the future to have duplicate systems anymore. We are not going to be able to have an education system inside of IBM that will function to teach people things that they didn't learn in schools," Kyle Rone, an IBM manager who is on the University of Houston-Clear Lake Partnership team, pointed out at the IBM Sharing Conference. The Clark Atlanta/SouthernTECH proposal made a parallel reference: "Both institutions are acutely aware of the tremendous amount of resources that companies are expending to educate and train employees in TQM concepts, principles, and successful tools and methodologies."

Other customers have expectations, as well. The Georgia Institute of Technology's proposal states that one of its incentives to adopt the TQM paradigm on a comprehensive basis was the call by the Regents of the University System of Georgia and the Southern Association of Colleges and Schools for comprehensive assessment. The University of Maryland proposal made the identical point:

> *"The Maryland legislature ... is also providing an impetus to focus on quality and accountability. All Maryland institutions of higher education are being held accountable to the citizens of the State and are required to provide evidence of achievement along qualitative and quantitative indices of educational outcomes. The measurement and feedback requirements underlying the State's accountability guidelines tie directly into the data and measurement needs of the University's continuous improvement strategy."*

Clark Atlanta University and Southern College of Technology

The Clark Atlanta/SouthernTECH team generated numbers of TQM curricular and research initiatives. Some were similar to those proffered by other institutions, some of its initiatives were unique, in the attention to process and measurement, for instance. But the obvious mark of distinction in the proposal was the issue of diversity. One of the most pervasive topics in industry is how to manage an organization with a diverse constituency, thereby maximizing the efficiency and effectiveness of the corporation. The Clark Atlanta/SouthernTECH proposal described a major research thrust in this area.

Clark Atlanta University is a newly formed school (1988). Its organizational ancestry is Clark College, the nation's oldest Methodist-affiliated, historically black liberal arts college, and Atlanta University, the nation's oldest historically black graduate school offering advanced academic and professional degrees. Clark Atlanta is located in inner-city Atlanta, Georgia. Today the University has more than 4,000 students, representing fifty countries and nearly every state in the nation.

Southern College of Technology was established in 1948 as a two-year technical arm of Georgia Tech. In 1980, SouthernTECH separated from Georgia Tech and became a senior college of the thirty-four-institution University of Georgia system. SouthernTECH awards more degrees in engineering technology than any other college in the nation. Currently, fourteen undergraduate and five graduate degrees are offered in engineering technology. SouthernTECH is 80 percent white.

There is, however, a vast difference between "studying" a phenomenon and living it. And that is Clark Atlanta/SouthernTECH's true distinctiveness. Each institution has rec-

Whether the customer is industry, state government, an accrediting association, or any other group that uses or benefits from higher education's output, the message is clear: There needs to be a far better match between the services that our colleges and universities produce and what their customers require.

Renewing the Academy

Most organizational behaviorists believe that the primary impetus for change is external. There also is reason to believe that professional bureaucracies — institutions, such as universities and hospitals, that are staffed largely by semi-autonomous professionals — need an additional nudge from an outside source. Nonetheless, the IBM-TQM Partners believe that there must be an internal component, as well. One such component is a generalized notion, perhaps a cultural value, that the institution must be willing to renew itself.

The University of Houston-Clear Lake's president, Glenn Goerke, made an interesting observation at the IBM Sharing Conference: "We're doing a pretty decent job of beginning to help business in this country change without ever changing ourselves." He went on to comment on how higher education has lost public trust and that the quality movement should be viewed as a "wake-up call." Specifically, he said, "Promotion and tenure, the way we're doing them, is obsolete. The reward system is obsolete. Advising and counseling is obsolete. It's time to change."

ognizable strengths, each has liabilities. Individually, each could make incremental improvements in its operations, coursework, and research endeavors. But by collaborating, by working together to leverage their strengths, they are in a unique position to make major gains. Edward Irons, Clark Atlanta University's business school dean, began his comments at the IBM-TQM Sharing Conference by saying, "I want to stress to you that the award was made to two schools by IBM, but it was really made to us as a team. We each have brought something different to this partnership."

Indeed, the Clark Atlanta/SouthernTECH partnership is, as stated in the joint proposal, "a living laboratory." The institutions will study themselves. They will advance our understanding of the impact of TQM implementation on diversity issues not only by conducting formal research in industry but by engaging in rigorous self-assessment. The stakes in this living laboratory thrust are not insignificant. The potential benefits to both institutions, IBM, and the community-at-large are clearly described in the proposal:

"Both educational institutions will produce more competitive students; ... the faculties of both institutions will enjoy opportunities for research and publications and professional development; the institutions will emerge with in-house quality management systems; the community-at-large benefits through the greater applicability of TQM training alternatives and university-assisted applications; the community also benefits from more effectively run institutions of higher learning; ... the benefit to the minority business community can be measured in increased competitiveness and a more solid market position."

This same clarion call to renew the academy was embedded in many Sharing Conference speeches and competition proposals. At the conference, for example, professor Judy Olian, one of the principal investigators in the University of Maryland's proposal, said, "We recognize, as was said here a number of times, that the successful universities of the year 2000 are going to look very different from many of the universities that are successful today." She then explained how TQM was a philosophy and set of tools and techniques that enabled an institution to engage in an active, on-going system of self-assessment and self-renewal. Her sentiments reflect those of Maryland's president. As William Kirwan stated in that proposal's cover letter: "I am convinced universities must fundamentally alter their educational strategy and institutional infrastructure.... I believe that the plans reflected in this proposal are a significant means of transforming the University of Maryland."

In effect, Total Quality Management was seen by the Partnership universities as a synonym for cultural transformation, as a way to renew the academy through systematic and comprehensive change.

Improving Operational Performance

The final driving need that emerged is the desire to improve the efficiency and effectiveness of internal processes. Within the context of "renewing the academy," this need focuses on specific actions that must be taken to improve the way in which the institutions operate.

For instance, Tim Gilmour, Georgia Tech's vice president for planning, said, "Georgia Tech takes in one of the best student bodies in the country, yet we only graduate 65 percent in six years. We think there is something wrong — a systemic problem." He went on to explain how the principles, tools, and techniques of Total Quality Management were beginning to be used to address such fundamental issues.

Glenn Freedman, of Houston-Clear Lake, discussed the infrastructure and governance problems there stemming from having ninety random committees and data redundancy: "We haven't been in a situation where we didn't have institutional research. We had IR overload. Everyone had their own little IR office. Everyone had their own books, had their own computing operation. We had triple redundancy on almost every key feature."

Administrators from both the Pennsylvania State University and the University of Wisconsin-Madison spoke at length at the TQM Sharing Conference about the need to improve such crit-

ical processes as teaching and learning; advising; recruiting faculty, staff, and students; developing curriculum; and scheduling classes. Indeed, every institution had its own stories to tell — of $25 requisitions that required seven signatures, of policies and procedures that hassled and degraded students, of graduation rates and triple redundancies.

Summary

The Partnership universities articulated an important series of answers to the question, Why should colleges and universities be interested in applying the principles of TQM to how they develop and deliver their services? Why? Because they believe a quality-driven approach will help their institutions forge more effective partnerships with their primary customer, industry, in an age where economic power is vital to the well-being of the country; it will enable them to become more responsive to the expectations of those they serve — their students, elected officials, and so on; it will allow them to nurture a feeling of self-renewal and develop the means to actualize self-assessment procedures; and it will provide the institutions with a methodology and accompanying set of tools to make work processes more effective and efficient. ■

Chapter 2 Curriculum Development

The principles of Total Quality Management are being applied throughout corporate America. Statistical process control is used to increase productivity and reliability of manufacturing processes, team-building techniques are used to break down the barriers between units, survey and focus group research records the voice of the customer. These are some of the basic tools and competencies that many companies feel college graduates should possess. It is not surprising, then, that 40 percent of the judging weight in the IBM-TQM competition was given to curriculum development.

Several themes were evident in the many proposal pages devoted to this subject. The initial theme was a clear focus on undergraduate coursework. The guidelines did not limit curriculum development to any student group. Indeed, in some of the proposals there were references to graduate courses, to executive education, and to continuing education. Nonetheless, the institutions applied most of their limited resources to the undergraduate curriculum. Perhaps the best explanation for this was offered by the University of Maryland: "The principal curriculum changes proposed here concern the [undergraduate curriculum] experience since this is where the potential economic and educational impact is greatest."

A second theme that emerged from the proposals was a sharply articulated intent: that the institutions were not interested in graduating "specialists in quality." The University of Wisconsin-Madison, for example, in discussing its idea to create a series of modules, said, "The intent will be to identify the key sequences of core courses taken by undergraduate engineering and business majors, and build a knowledge base of quality concepts and methods over their four-year university experience. On graduation, the student will have a strong foundation in TQM and its relation to his/her discipline." The thrust seems to be to graduate students who possess a natural orientation toward quality principles and a set of practiced skills.

A customer orientation was the final theme. In all cases, the institutions made specific references to using industry expectations to drive the curriculum development process. The principal investigators at the Rochester Institute of Technology made the point at the very beginning of their section on curriculum development: "The whole RIT culture is one of listening carefully to career requirements of its students and employers who hire them. Increasingly, the focus of many of these employers has been on quality, delivery, and customer satisfaction." The schools were eager to work with industry to develop outcome competencies then use that information to frame the courses and class materials.

This "Curriculum Development" section of the report reflects six specific intentions of the universities: TQM Across the Curriculum, TQM Coursework, Degree Programs and Concentrations, Facilities and Technology, Partnerships, and Process Management. The first two parts deal with the manner in which the institutions chose to introduce TQM principles into their curricula — either with separate courses or by embedding the material in existing coursework. While not extensive, there was some interest in developing specific degree programs or adding concentrations to existing majors. The fourth part describes the proposed use of facilities and technology in curriculum development. Next, many of the institutions were interested in generating partnerships to facilitate one or more aspects of curriculum development. The final part enumerates the special attention that was given to "process" by the grant-winning universities.

TQM Across the Curriculum

Higher education has had a series of "across the curriculum" initiatives, the most noteworthy being "writing across the curriculum." The logic of such an approach is compelling: Since learning is most readily facilitated through a process of association, embed the material — in this case, TQM philosophy, tools, and techniques — across a broad array of traditional subject areas.

From a practical point of view, there are two additional arguments to be made for pursuing this approach to TQM curriculum development. First, most of the Partnership institutions made purposeful declarations of extremely wide scope. At the University of Maryland, for example: "... we will spread TQ throughout the curriculum of each of the 1,600 engineering and business students admitted every year into the two Colleges." Georgia Tech went one step further: "We plan for every undergraduate student to graduate from Georgia Tech with an understanding of the TQM philosophy and the essential knowledge, skills, and practical experience to make an immediate and positive contribution to the productive work of an organization." Meeting such goals requires a comprehensive curriculum methodology.

Second, an "across the curriculum" approach addresses a very real problem that most business and engineering programs face — too many required courses. The UW-Madison proposal said it well: "Business and engineering students' university programs are already completely filled with required courses on engineering design, engineering science, marketing, finance,

accounting, and management, which rightly are the mainstay of the curriculum." The proposal goes on to note, "Adding new required courses would be exceedingly difficult and would be ineffective in integrating these vertical functions under TQM; yet, new knowledge needs to be learned."

Several methodologies for teaching TQM "across the curriculum" emerged from the proposals. Perhaps the most expansive methodology was the use of the Malcolm Baldrige National Quality Award examination categories. The award recognizes U.S. companies that excel in quality management and quality achievement. The examination has seven categories in leadership, information and analysis, strategic quality planning, and so on. Both Oregon State University and Georgia Tech plan to rely on the criteria (categories) to drive their curriculum development. As *Exhibit 1* (on the next page) illustrates, the criteria can be used as a set of competencies to be infused into existing courses or to focus attention on particular teaching strategies:

Exhibit 1. *Georgia Institute of Technology Curriculum Development*

PARALLEL CRITERIA FROM MALCOLM BALDRIGE NATIONAL QUALITY AWARD	KNOWLEDGE/ SKILL TO BE DEVELOPED	POTENTIAL LOCATION WITHIN THE CURRICULUM
Strategic Quality Planning	Strategic Planning Self Analysis	Initial Freshman course; application exercises tied to career planning and plan of study at Georgia Tech; "career" advising
Human Resource Development and Management	Working in Teams, group decision making	Introduction using team assignments given during the calculus series; refinement during interdisciplinary project team courses; electronic group decision making sessions using "groupware"
Leadership	Leadership	Initial Freshman course; refinement and practice during team assignments and group projects
The Quality Assurance System	Continuous Improvement	Introduction during initial freshman course; reinforcement in most required courses; at least one improvement team participation experience before graduation
Information and Analysis	Measurement; understanding variation	Weave statistical methodology and application through the physics and chemistry laboratory experience; require statistical thinking during interdisciplinary group projects
Customer Focus and Satisfaction	Customer focus	Introduction in initial Freshman course; reinforcement in most required courses

Another approach is to merge TQM materials into a limited set of core courses. In 1991, an undergraduate study group was appointed to recommend revisions in the Pennsylvania State University business program. The committee recommended that the core knowledge to be required of all undergraduates be taught not in a set of independent, essentially unrelated courses but through four closely integrated courses. The four college-wide courses would be taken by all business students during the first semester of their junior year.

The Penn State plan, which was adopted by the business faculty in 1992, integrates TQM across all four team-taught courses, with the basic principles being included as a module in Business Administration 302:

> *Business Administration 301:* Finance, Risk Management, Law and Regulations of Finance, Real Estate Management, Information Systems for Finance, Quantitative Modeling for Finance
>
> *Business Administration 302:* Total Quality Management, Operations Management/Manufacturing, Purchasing/Materials Management, Information Systems Operations
>
> *Business Administration 303:* Marketing, Physical Distribution/International Logistics, International Business/Global Marketing, Law and Regulations Marketing, Quantitative Modeling in Marketing
>
> *Business Administration 304:* Corporate Strategy, Human Resources Management, Organizational Design, Social Responsibility and Ethics, Leadership Skills, Managing in the Diverse Workplace

The final approach to teaching TQM "across the curriculum" is based on the development of curricular modules — that is, teaching materials for individual knowledge elements, ranging from one hour of teaching time to several weeks, and including lecture notes, examples, visual aids, homework problems, and so on. The University of Wisconsin-Madison has committed to integrating TQM modules into the curriculum. Its initial proposal calls for three general groupings: management, quantitative, and communications. Example modules within management might be benchmarking, systems thinking, employee empowerment, teamwork, and

process management. A planning team of faculty from UW-Madison and partner universities, with industrial counterparts from IBM and other quality-focused companies, will plan, identify, and prioritize (i.e., the "Plan" stage of the Plan-Do-Check-Act cycle) the vital curricular modules based on customer needs (i.e., students, employers, sponsors).

The prioritized modules will be developed at UW-Madison and tested at UW-Madison and at the partner institutions. This "Do" stage will subsequently be expanded to wider scale dissemination via train-the-trainer workshops. The "Check" stage will involve student and faculty feedback on the strengths and weaknesses of the modules. The "Act" stage will include making the modules permanent components of the core courses. *Exhibit 2* illustrates this integration process.

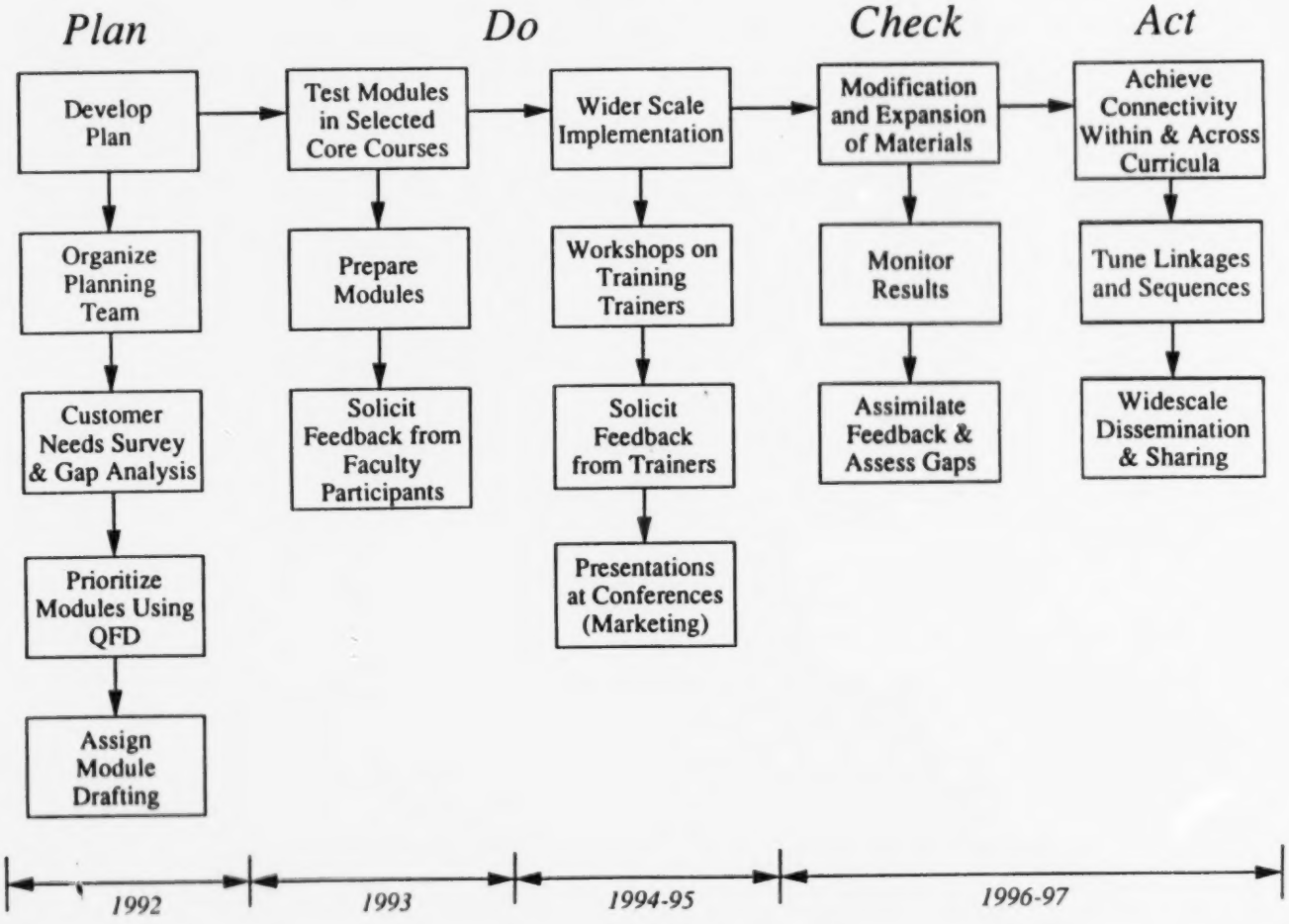


Exhibit 2. *Process for Integrating TQM Modules Into Core Courses at UW-Madison*

There are several distinct advantages to this approach: The UW-Madison investigators believe that the proposed integration process will make acceptance at their university more likely, as well as enhancing the transportability of the curricular materials to other universities.

TQM Coursework

Most of the competition-winning institutions had some stand-alone TQM coursework in place prior to their entering the competition. Further, most decided to develop new courses as part of their TQM initiatives. While there are many illustrations of individual TQM courses being taught or proposed, it is important to describe two pedagogical approaches that emerged: sequencing and introduction-and-capstone.

The sequencing approach consists of a series of individual courses that are both linked and required. One institution using sequencing is the University of Maryland, which is developing an undergraduate concentration of four courses on various aspects of TQM (overview, global competitiveness, measurement, practicum). Students, working in engineering and business teams, will take one course in each of four years, supplemented during the off-semesters with executive seminars, internships, and co-ops. The four-course sequence is:

Georgia Institute of Technology

At the very heart of TQM is the concept of continuous improvement. Those who practice continuous improvement in their operations have a healthy discontent for the status quo. They know that the environment changes, technology advances, competition improves, and customer preferences shift. They always aspire to do better. They are in a constant search for new ways to do things, more elegant or simpler solutions to problems, processes with fewer steps.

Georgia Institute of Technology has every right to be content. The average SAT scores (1203) and high school grade-point average (3.6) of its entering freshman class indicate it has among the best student bodies of all public universities in the country. Tech attracts a large number of National Merit Scholars and National Achievement Scholars each year. It is a major supplier of engineering talent (1,762 of its 2,807 graduating students last year were engineers).

The faculty is strong. Approximately one-third of the engineering faculty are registered professional engineers. And Tech consistently ranks in the top ten (in dollar volume) of sponsored research among all universities conducting engineering research. It is also a leader in dollar volume of industrially supported research.

In spite of all this, Georgia Institute of Technology's proposal to IBM was laced throughout with references that suggested the Institute wanted to, indeed needed to, get much better. The first few sentences of the executive summary set the tone: "Georgia Tech has recently completed the first cycle of a comprehensive strategic planning process. The principal conclusion from that effort is that Tech must

Introduction to Engineering Design and Quality: An overview of the systematic frameworks for TQ and the implementation of quality through product design, specification, costing, management, marketing, and measurement

The Measurement of Quality: Defining and measuring quality and the costs of quality and statistical tools that assist in planning for, implementing, and evaluating continuous improvement

Quality Strategy: A Global Perspective: Understanding and integrating corporate strategy and strategic quality management within the context of a domestic and international market environment

Total Quality Practicum: An in-depth organizational internship, with a final presentation before customer groups, who will grade the success of the change process. The internship will be brokered by the Maryland Center for Quality and Productivity (MCQP) and Technology Extension Service (TES), to tie into their outreach activities among Maryland businesses

In the introduction-and-capstone approach, the institution concentrates resources on the development of a comprehensive "introduction" course, which is often accompanied by a senior-level capstone course. A TQM introduction course offered by Oregon State

transform its organizational culture. ... In order to transform our culture, we recognize that business as usual will not do, and that a radical paradigm shift is required."

Each section of the proposal contained a sense of urgency — "This proposal contains a plan to alter our curriculum radically...." In another paragraph, the institution stated its need to "... completely revamp operations throughout the organization, and to achieve these aims through intensive collaboration with the business community." The language left the reader with the feeling that a shift is preferable to a nudge, that healthy discontent is better than the snug comfort of the status quo, and that being out in front of the wave provides a much better view (and ride) than being in the back of it. The best example of this was a reference to the call from the Regents of the University System of Georgia and the Southern Association of Colleges and Schools for comprehensive assessment at member institutions. Instead of reacting to the situation or dismissing the call as one more example of intrusion, Tech suggests that by implementing TQM it can meet and exceed the assessment obligations effectively.

And where does all this end? Tech also was very clear about what all this meant. Why embrace change? Why do things differently tomorrow when the way they are done today is perfectly adequate? Because being adequate will never enable Tech to reach its stated goal of becoming "the premier technological university of the twenty-first century."

University's College of Business, for example, teaches students TQM concepts that can be applied to organizational processes. The students also complete a Hoshin planning exercise and make a case presentation of an organization using TQM.

At the Pennsylvania State University, the College of Engineering offers an introductory undergraduate course, "Engineering Statistics and Quality Methods," designed to accomplish the goal of teaching engineering analysis methods, together with the Total Quality framework in which they are practiced in world-class companies. As part of the TQM initiative, the course currently is being taught as a prototype to three sections of students, but eventually it will become part of the core curriculum for all engineers. New pedagogical techniques, specifically the organization of students into teams, will be introduced next year. By 1995-96, the course will be required for all junior-level engineering majors. The course outline is shown below:

1. Overview of Total Quality Concepts: Baldrige Award criteria; philosophies; Taguchi loss function; the role of statistical and probabilistic thinking in engineering and quality improvement; a model for process improvement

2. Probability: fundamental concepts; probability distributions (binomial, hypergeometric, Poisson, exponential)

3. Introduction to Reliability: definition of terms; exponential failure model; series/parallel/combination systems; redundancy

4. Descriptive Statistics: mean, median, mode, range, variance, standard deviation; graphical tools in statistics; tools for understanding a process

5. Sampling Distributions and Estimation/Inferential Statistics: distributions (Z, t, X^2, F); confidence intervals; hypothesis testing

6. Introduction to Statistical Process Control: statistics for monitoring and stabilizing a process (control charting/process capability); understanding tolerances and measurement error

7. Regression Analysis: simple regression; correlation

8. Introduction to Design of Experiments: analysis of variance techniques; factorial and fractional factorial designs; Taguchi designs

9. Quality Function Deployment: what is QFD?; building the house of quality; examples

> Several institutions coupled a capstone course with an introduction course. At the Pennsylvania State University, a new one-credit interdisciplinary seminar has been proposed to expose business and engineering seniors to world-class quality organizations. Representatives of industry, service, government, and educational institutions will be invited to talk about the role of Total Quality within their own organizations.

Finally, as was mentioned, many of the institutions decided to push forward with the development of individual courses. The content of such courses is narrowly focused on TQM issues. The courses are not part of a sequence. Examples of the types of coursework being developed include the following:

> *University of Wisconsin-Madison, School of Business:* "Quality Function Deployment"; "Strategic Quality Management"; "Planning for Total Quality"; "Leadership and Facilitation in TQM"
>
> *University of Maryland, Department of Continuing Education:* "Quality and Productivity Measurement Systems"; "The Changing Role of the Supervisor in a TQM Environment"; "Benchmarking"; "Implementing TQM — The Change Agent's Road Map"
>
> *University of Houston-Clear Lake, School of Natural and Applied Sciences:* "TQM for Systems Engineering Processes"; "Computer-Aided Software Engineering Support to TQM"; "Quality Assurance Role in TQM"

Degree Programs and Concentrations

As stated in the overview to this section, the consensus among the IBM-TQM Partnership institutions was to avoid creating "specialists in quality." None of the universities proposed anything resembling a "TQM major." Nonetheless, several existing programs or proposals go beyond offering a series of elective courses or developing an "across the curriculum" approach. UW-Madison, for example, initiated interdisciplinary graduate concentrations in Total Quality in 1990-91. There, a graduate student can earn an M.B.A., M.S., or Ph.D. in business with a TQM concentration; an M.S. or Ph.D. in industrial engineering with a quality engineering concentration; or an M.S. in statistics with a quality and productivity improvement concentration. All students are required to take courses related to TQM, quality engineering, and applied statistics to complete each of these concentrations, so there is a cross-functional experience in the learning process.

The Pennsylvania State University is in the final stages of developing a master's degree in quality and manufacturing, to be offered jointly by the colleges of Business Administration and Engineering. The following are the program's tentative core courses:

> *Engineering:* manufacturing processes and materials, Total Quality systems, computer-integrated manufacturing, statistical process control
>
> *Business:* team building and leadership, time-based concepts in manufacturing, cost activity-based information systems, design for manufacturability and quality

A unique feature of the program is that students will be organized into four-person teams, two from engineering and two from business, in all core courses. Students will receive grades based principally on the performance of their team.

The most broad based approach is that being pursued by the University of Houston-Clear Lake. Degree programs with a TQM concentration are planned in four schools:

> *School of Business and Public Administration:* Public Management; Master's in Business Administration; Management Information Systems; Health Care Administration
>
> *School of Education:* Superintendents Certificate; Principals Certificate
>
> *School of Human Sciences and Humanities:* Communications; Futures Studies
>
> *School of Natural and Applied Sciences:* Software Engineering; Computer Engineering; Computer Science

In each of the schools, a series of courses is being developed. The School of Education, for example, will offer "TQM Systems for Public Schools," "TQM Systems for School Administration," "Cross-Functional TQM Integration Process," and so on.

Finally, SouthernTECH has committed to offering an ambitious certificate program, entitled "Executive Quality Management," in its School of Management beginning in 1995. (SouthernTECH will pilot the program, with Clark Atlanta University entering into a joint

agreement for its students to participate.) The long-range goal is to have a national broadcast of the program via satellite, with one-way video and two-way computer interaction. The process being used by SouthernTECH to develop this program is as follows:

- Form a "project" team comprising internal and external representatives to identify what courses would be included in a certification program.
- Conduct brainstorming sessions, utilizing the DACUM method, to determine competencies or participant outcomes.
- Develop a project implementation plan to identify the different phases and levels of implementation.
- Seek out the expertise of IBM personnel and other telecommunications experts to design the satellite delivery and communications system.
- Contact other colleges and universities that have been involved with satellite uplink programs for assistance in instructional development and uplinking procedures.
- Pilot the uplink program with Atlanta-area businesses.
- Uplink the certification program on a national level.

Facilities and Technology

The IBM-TQM competition guidelines allowed institutions to designate equipment instead of cash (or a combination thereof, with equipment counted 3:1 to cash). Consequently, there was a significant effort by some institutions to identify ways of using technology to support the improvement of curriculum development. The dominant approach was to propose an "electronic classroom" — e.g., the University of Wisconsin-Madison's Technical Communication Laboratory; a TQM Laboratory for Engineering at the Pennsylvania State University; three computer labs at SouthernTECH and Clark Atlanta University; and the University of Maryland's IBM Ultimedia Theater.

The equipment needs are based on the proposed learning environments. The IBM Ultimedia Theater, for instance, will be a single laboratory physically distributed between a room in the College of Engineering building and a room in the College of Business, with communications being provided by the campus's new optical fiber-based network. Thirty-seven lab workstations (IBM PS/2 90) and twenty classroom workstations (M57 Ultimedia SLC) will be used. Penn State also will be using workstations (PS/2 65SLC) for an engineering lab. The Technical Communications Laboratory at UW-Madison will consist of three parts: a presentation studio, a document design center, and a usability testing center. A team of IBM and UW-Madison consultants will recommend the exact hardware.

The software for the labs will, again, be application-specific. For example, the SouthernTECH/Clark Atlanta facilities will help deliver generalized instruction. They are considering the following software packages: Quality Planning, Benchmarking, Customer Satisfaction Indicators, Culture Assessment, and Process Analysis. The Pennsylvania State University's engineering lab will focus more on data analysis tools — control chart packages and statistical analysis packages — and simulated manufacturing processes.

The University of Maryland is making the most ambitious plans. Its Academic Software Development Group, a collaborative effort with IBM's Academic Information Systems, is developing a comprehensive set of multimedia materials for teaching and learning TQM in industry and higher education. According to the University of Maryland proposal:

> *The materials under development are rich enough to support courses covering TQ issues from many perspectives, and the hypertext authoring environment in which this development is taking place will allow multiple custom offerings to be quickly and easily developed. In addition to the presentation modes developed directly with AICS, these materials are readily adaptable to support the four-course sequence proposed for use in the Ultimedia Theater. Among the most exciting components of materials are the simulation of systems and system intervention strategies. Classic TQM exercises can be simulated; for example, Deming's red beads experiments, and the marbles through the funnel exercise.*

Oregon State University

The search for a new management paradigm at Oregon State University began in 1989. Faced with downsizing while trying to improve the quality of its operations and services, OSU found a likely candidate in the Total Quality system used by major corporations such as IBM, Xerox, Motorola, and Hewlett-Packard.

The institution saw TQM's positive potential in meeting major university challenges such as unhappy customers, lack of resources, and low employee morale. During this exploratory phase, the OSU leadership visited companies with TQM programs, invited W. Edwards Deming to visit and explain TQM, read key resources, and attended TQM seminars and classes.

The result of this exploration was a commitment to a comprehensive, five-year TQM Implementation Plan, which details issues such as training methods, infrastructure, team processes, problem-solving processes, and strategies. For example, OSU made a conscious decision to start on the administrative side and generate successes before encouraging the academic side to explore TQM's applicability for teaching and learning. In addition to developing a plan, OSU took another important step. Using Plan-Do-Check-Act cycle thinking, it incorporated a rigorous assessment, or "check," phase.

Oregon State University decided to use the Malcolm Baldrige National Quality Award as a way to establish specific performance criteria. While the Baldrige Award was established to recognize companies that excel in quality management and quality

Several institutions requested funding to pilot-test IBM class response equipment. The University of Wisconsin-Madison, for example, will attempt to use class response equipment to augment teaching in "Contemporary Issues in the Engineering Profession." The large lecture course, which currently enrolls almost 600 students, provides engineering students with their first introduction to quality concepts in manufacturing and engineering design. The proposal notes that part of the grade in this class comes from quizzes, which are given on a take-home basis because of the impracticality of administering them in class. Also, evaluation of the course's instruction and content takes place on the last day of class.

Class response technology, using individual keypads for students, would make it possible to improve the class in several ways: to give quizzes in class, to provide immediate feedback to the instructor on student grasp of key concepts, and to provide ongoing evaluation of the course content and instruction to allow continuous improvement.

Partnerships

Another important aspect of curriculum development that emerged from the proposals involved partnerships. It is possible to view "partnering" from three perspectives: peers, suppliers, and customers.

achievement, the core values and concepts embodied in the seven examination categories have relevance to higher education. Those categories are: (1) leadership, (2) information and analysis, (3) strategic quality planning, (4) human resource development and management, (5) management of process quality, (6) quality and operational results, and (7) customer focus and satisfaction.

Continuous improvement requires hard goals, thoughtful implementation, evaluation for the purposes of exposing gaps, and a reshaping or reinventing phase. Unfortunately, the tendency is to generate the Plan, implement the Do, and then forget about the Check. The IBM-TQM competition guidelines paid specific attention to evaluation. IBM asked institutions to demonstrate evaluation and measurement processes to evaluate the success of TQM initiatives.

Oregon State University's proposal made a commitment to continuing to use the Malcolm Baldrige categories as a self-assessment tool. Moreover, the university looked to working with IBM, a previous Baldrige Award winner, to help improve its present use of the categories to drive the goal-setting and data-gathering processes. Performance enhancement, and a system or framework to guide action and adjustment, is seen as a key element in the transformation to a new culture of quality at Oregon State University.

Several of the grant-winning institutions discussed some type of partnership with one or more peer universities in the curriculum development area. For example, the University of Wisconsin-Madison stated in its proposal that it would seek to develop its management modules by working with the University of Chicago's Business School. The intent, in this case, is to collaborate with faculty members at other institutions who have similar interests and complementary skills, thereby minimizing the resource input and maximizing the knowledge output.

Other institutions — Georgia Tech and Penn State, for example — have specific plans to develop "partnership" relationships with their K-12 suppliers. The Penn State Integrated Model views teaching and learning as a continuous educational process, from pre-school through graduate school. Working with suppliers is a key means of improving quality, and Penn State identified two initiatives in its IBM-TQM proposal:

- Work with supplier schools to identify competencies needed for success in business and engineering programs, and help schools revise curricula to develop those competencies.
- Extend current AS400 advising project to secondary schools for curriculum planning.

Penn State has established a Center for Total Quality Schools (CTQS) in its College of Education, and it has begun a five-year project with the colleges of Business Administration and Engineering to improve linkages with suppliers. In year one, first-year students' level of preparedness will be analyzed, and the competencies needed for success in each college will be identified. In year two, process improvement teams will be established with members from the supplier school districts, Penn State faculty from Business and Engineering, and CTQS personnel. These teams will "work to match the necessary student competencies with the high school and University curricula, to develop strategies for transforming high school curricula to produce the required competencies, and to maintain the communication between high schools and the University."

Penn State's College of Business Administration is working with IBM to develop an expert system allowing undergraduate students to seek advising about their curriculum choices through the AS400 computer. The idea, according to the proposal, is to extend the advising

system to secondary schools for curriculum planning: "Through an interactive network, it is anticipated that high school administrators, guidance counselors, and students will be able to query the system to plan high school coursework appropriate for intended college majors."

The final "curriculum partnership" involves customers/employers. All of the institutions mentioned are developing some type of relationship with industry. The key thrust of these relationships is to establish a means by which competencies or requirements can be communicated. For example, the University of Houston-Clear Lake suggests that "the planning phase begins by seeking customer requirements from the community through workshops and other devices." The Clark Atlanta/SouthernTECH proposal detailed the establishment of an external advisory committee with representatives from organizations with a proven TQM implementation track record: "This committee's purpose would be to identify a set of TQM core competencies that embodies the major concepts, philosophies, principles, and methodologies."

Partnerships, then, extend three ways: Upstream, to communicate requirements and to aid in the development of appropriate skills; downstream, to generate end-user expectations; and peer relationships to leverage scarce resources.

Process Management

A critical part of implementing Total Quality Management involves process management — identifying critical processes and working to ensure that they are effective, efficient, under control, and adaptable. It is especially gratifying to see the attention that the grant-winning proposals gave not just to "TQM courses" and "TQM concentrations" but to the process of curriculum development. As shown previously in Exhibit 2, "Process for Integrating TQM Modules Into Core Courses," UW-Madison is a worthy illustration. Indeed, the comment made in UW-Madison's proposal was: "Our commitment includes not only the development of new courses but a system change involving the improvement of the curriculum development process so that it is customer-focused and continuously improving." The implications for such an orientation go far beyond the teaching of Total Quality Management principles; they speak to developing a continuous improvement process for curriculum development.

Perhaps the most comprehensive process orientation was that proposed by the Rochester Institute of Technology. Its perspective on curriculum development is as follows: "We are looking at input, educational process, and output. The input or 'raw material' is determined

through the admissions process; the educational process consists of course content, teaching methodology, learning environment, and their impact on learning; and the output relates to how to measure success, employers' assessments, on-time graduation, continued lifelong learning, and citizenship."

Rochester's colleges of Business and Engineering have identified eleven steps in the process of integrating TQM into the curriculum:

1. Obtain administrative commitment.
2. Develop a mission statement and gain acceptance by faculty.
3. Provide training in TQM principles and processes.
4. Identify customers and their needs.
5. Form a joint COB-COE team to coordinate cross-functional activities.
6. Undertake self-assessment of each program and the educational processes.
7. Benchmark selected areas.
8. Develop detailed curriculum within each program.
9. Establish appropriate performance measures and feedback instruments.
10. Implement the curriculum in each program.
11. Monitor performance against established criteria.

Pennsylvania State University

By most traditional measures of quality, the Pennsylvania State University is one of the premier research universities in this country. In recent years, it has been among the top five in industry funding; it ranks sixteenth nationally in the number of doctorates awarded annually; it is the second-largest producer of baccalaureate degrees in engineering; and the list goes on.

Nonetheless, in September 1991, president Joab Thomas and executive vice president and provost John Brighton appointed a University Council on Continuous Quality Improvement. They charged the council to explore the applicability of Total Quality Management concepts for Penn State, to initiate a program for educating the university community about Total Quality concepts and developments, and to promote the continuous improvement of institutional processes.

Most recently, the university has developed a new vision statement that incorporates Penn State's commitment to the principles of Total Quality Management:

Penn State as a premier public research university is respected for the quality of the education it provides to its students, for the excellence of its research and scholarship, and for the service it renders to the citizens of the Commonwealth, the nation, and the world. Our distinction will be recognized further by our commitment to continuous quality improvement, creating an environment in which everyone takes ownership of the educational enterprise and in which high value is place on teamwork, collaboration, and communication.

Clark Atlanta University and SouthernTECH have made a commitment to integrating TQM concepts, principles, and methodologies into the core curriculum of all undergraduate and graduate degree programs. They also have taken a process approach to implementation. Their approach includes (1) arranging for faculty orientation to TQM, (2) establishing an advisory committee to identify TQM competencies, (3) reviewing existing curricula, (4) performing a gap analysis, (5) creating a cross-disciplinary team to develop curriculum, (6) validating the curriculum with nationally recognized quality experts, and (7) incorporating the new curriculum into program areas.

A summary observation needs to be repeated. Curriculum development in higher education typically means the proposal of individual courses by professors who have an interest in teaching in that area. There are few "across the curriculum" efforts and little sequencing. With the exception of a college's or department's curriculum committee, hardly any other sources are consulted. The key criterion for adoption usually is the number of students the course attracts on an experimental basis.

The curriculum development efforts described in this report are different: They often link courses into a competency-building sequence, with the entire process being driven by both internal and external customer needs. ■

Penn State's IBM proposal built on this broad-based institutional commitment in the areas of curriculum, research, and operations with specific and creative initiatives. But the institution's most unique contribution to the Partnership is not found in the details of its proposal; it is in the articulation of the Penn State Integrated Model — a model that identifies educational processes as providing added value between suppliers (K-12 schools) and the employers of graduates.

As the proposal's authors note:

"Historically, the quality of an institution of higher education has been established through accreditation, either of its individual programs or of the university as a whole. Within the accreditation framework, quality is considered an attribute that can be measured by such inputs as the number of books in the library, the size of the budget, or the number of faculty members holding a Ph.D.... More recently, many states have mandated the implementation of comprehensive accreditation programs, in which quality is judged by the inspection of outputs, frequently by measuring graduation and attrition rates or by standardized tests."

In contrast, the Penn State Integrated Model adopts Deming's systemic view of organizations, in which quality stems from the comprehensive interface between suppliers, design, processes, output, and customers. By improving the competencies of incoming students, by developing curricula more responsive to customer needs, by improving the effectiveness and efficiency of instruction and administrative operations, and by developing an effective feedback loop from customers to process, "we will be institutionalizing the continuous improvement of the entire educational process."

Chapter 3 Research

The research component of the IBM-TQM competition generated a broad-sweeping array of ideas and programs. But stepping back from the details of the individual initiatives, one is struck by a strong underlying theme — the willingness and desire of the institutions to "leverage" their time, energy, and scarce resources.

Research plans were not a function of the idiosyncratic interests of a small cadre of faculty members. Publishable results were not the sole criterion of success. Instead, the general approach was to look to industry for topic areas or, as the Georgia Tech proposal states, "... our research foci will be market-driven." The projects' principal investigators took a decidedly interdisciplinary and interinstitutional slant. Isolation, a trademark of the traditional faculty member, was replaced by collaboration. Institutions saw research results not merely as output, but also as input into an extended knowledge-development process. Many proposals had a field-testing component, in which industry would collaborate and then feed back initial results. The leverage also extended into the classroom. The Pennsylvania State University proposal said it succinctly and with emphasis: *"The incorporation of research results into our curriculum is considered an inherent part of our research effort."*

This section of the Report is divided into three parts: Application Areas, Process Management, and Partnerships. First, most of the proposals were focused on detailing a series of specific research initiatives or application areas. As with the Curriculum Development section, the institutions often described the process by which research initiatives would be developed and the process by which results would be disseminated. The final part highlights the type of collaborative arrangements, or partnerships, that many institutions are pursuing.

Application Areas

Much of the research discussion in the IBM-TQM proposals centered on targeted endeavors. The institutions were interested in pursuing knowledge development in two broad areas, as well as a series of specific applications. The first area covers the general category of "TQM in Industry." Most of the topics proposed were specific to either management or engineering. The second area is "TQM in Education." The inspiration for much of this research was

necessarily and appropriately self-centered — each school is interested in doing research on its own curriculum development and operations. Finally, there were also a number of highly specialized projects proposed that were based largely on the institutions' unique interests or capabilities.

Centralization and documentation is the overarching management initiative. The University of Maryland and Clark Atlanta/SouthernTECH, as an example, proposed research on the documentation of TQM implementation processes and results. As the Clark Atlanta/SouthernTECH proposal suggests, many singular sources of information and publications on "best practices" already exist; the research projects would gather that information and centralize it in computer databases. Clark Atlanta/SouthernTECH envisions that its macro database would be programmed to accommodate segregation of information according to critical elements — i.e., who, why, what, how, when, and future trends. A second goal would be to continue to add new information to the initial baseline and conduct longitudinal research on "best practices."

Rochester Institute of Technology

For whatever reason, we tend not to think in terms of processes. Our thought patterns and actions, instead, deal more often with individual events, not the series of activities of which those events are a part. Our institutions are probably more guilty of "event management" than other types of institutions. Academic freedom enables us to maximize the full range of intellectual choices within each classroom, but makes it difficult for us to improve the extended educational process. The disciplinary fragmentation of schools causes real problems when we try to understand and actively construct a meaningful general-education process. So there is no obvious reason why the Rochester Institute of Technology should be more process oriented than other colleges and universities.

RIT's primary mission is career education integrated with the liberal arts. It has nine colleges: Applied Science and Technology, Business, Continuing Education, Engineering, Fine and Applied Arts, Graphic Arts and Photography, Liberal Arts, Science, and the National Technical Institute for the Deaf. It's located in suburban Rochester, New York, a world center of photography and the largest producer of optical goods in the United States. RIT has 8,500 full-time and 3,000 part-time undergraduate and 1,700 graduate students.

Yet, if its IBM-TQM competition proposal is any indication, there is strong evidence to suggest that people at RIT are beginning to think holistically, to see steps and loops, and the connections between indi-

The University of Maryland initiative is driven by what the university perceives to be "a severe industry need for a 'best practices' database for benchmarking purposes; definition of quality metrics at the process, firm, and industry levels; and examination of TQ process factors that account for industry competitiveness." Specific research issues that will be addressed via its database include:

- A firm's business strategy (as viewed by top management) and its relation to the firm's manufacturing expertise.
- Correlation of the firm's business strategy with specific metrics available in the database
- Assessment of the firm's TQ developmental stage, against management perceptions of success factors.
- Inter-firm comparisons along particular dimensions of manufacturing processes among those that have graduated from the Maryland Center for Quality and Productivity TQM assessment process.
- Developing an analytical approach to determine and catalog best-in-class providers of services.

vidual events. The signs are everywhere. At the IBM-TQM Sharing Conference, for example, Paul Peterson, dean of the College of Engineering, talked about the process for developing a strategic plan in his college, the process for involving industry, the process for assessment, and the process for advising. In the advising area, for example, he said, "We really didn't have a systematic approach to assessing advising effectiveness. We assumed faculty members instinctively knew how to advise. They don't. We need to provide them with good advisement tools in order to run a successful campus, and now we're trying to do that."

RIT's proposal itself is an exercise in process management. Little time was spent detailing the specifics of coursework. A great deal of time, instead, was given to describing the eleven steps identified by the colleges of Business and Engineering in the process of integrating TQM into the curriculum. In research, rather than merely discussing a series of projects, the proposal enumerates a project criteria matrix — that is, the process by which projects will be selected. Moreover, the "identification of research projects" then became the initial stage for an eight-step process in which project activities would be monitored.

Finally, perhaps the best statement that reflects RIT's process orientation is also from its proposal: "The process of engineering education has changed very little over the past 100 years. It is imperative that in today's market we make significant improvements in the education delivery process."

IBM - TQM Partnership

Perhaps the most ambitious management-related TQM research program was proposed by a team from UW-Madison's School of Business. Their objective is to develop knowledge, methodology, and implementation procedures for TQM as a system of management with emphasis in four areas: daily management, strategic and policy management, cross-functional management, and new product and service development. Some of the specific topics within each of these areas are as follows:

> *Daily Management:* cycle-time reduction techniques, bottleneck analysis and constraint theory, improvement planning (incremental and breakthrough), fool-proofing techniques
>
> *Strategic and Policy Management:* adaptive policy deployment, benchmarking and measures of progress, customer-focused missions and visions, critical process identification
>
> *Cross-Functional Management:* characteristics of horizontal functions, advanced system structures for large organizations, effects of cross-functional management, examples and classification methods for horizontal functions
>
> *New Product and Service Development:* reliability deployment, House of Quality construction and analysis, analyzing customer behavior and use analysis, process management for new product development

Many of the institutions offered an accompanying set of research initiatives in engineering. For example, the College of Engineering at the Rochester Institute of Technology has formed an interdisciplinary Engineering/Research Planning team. It has selected four areas in quality on which to focus: (1) quality in integrated circuit manufacturing, (2) developing new educational processes to improve quality in engineering education, (3) developing a process to ensure quality in design, and (4) evaluating the time dimension of quality.

The College of Engineering at the Pennsylvania State University has a comprehensive research agenda based largely on its five-year "quality and manufacturing" partnership with General Motors Corporation. Two laboratories — the Statistical Quality Control Laboratory

and the Intelligent Design and Diagnostics Laboratory — are dedicated to research on graphical methods for the design of experiments, development of multivariate loss functions, and quality optimization methods for computer-aided engineering. They plan to extend research efforts in three specific areas:

> *Quantifying the Effects of Continuous Process Improvements:* The research proposed considers tools for estimating the benefits of specific process improvements, as well as tools for considering plant-wide or corporate-wide improvement programs
>
> *Process Capability Measurement and Feedback Control:* This project will focus on developing techniques for making adjustments to reduce variability in an automated (and frequent) way using scientifically developed feedback mechanisms
>
> *Graphical Methods for Designing Experiments:* PC software will be developed to allow interactive manipulation and study of graphical representations of experiment designs

UW-Madison's Center for Quality and Productivity Improvement will take the lead in pursuing programmatic research in the linkage between statistical process control and feedback-feedforward control, and in the construction of split-plot experimental designs. Such efforts amount to enhancing quality engineering methods to support TQM.

The second major research thrust that emerged from the grant-winning proposals can be labeled "TQM in Education." This thrust had either an internal or an external focus. First, many of the institutions developed a line of inquiry that allowed them to study the efficiency and effectiveness of their own curriculum initiatives. The University of Maryland is a good example of this approach. To understand the effects and effectiveness of learning in the IBM Ultimedia Theater, research will be designed to address the following issues:

- What is the optimal design of student workstation/user interface? Each student might have several windows opened at once, accessing different functions and information simultaneously. What is the best architecture for this interface?
- What is the best paradigm for the TQ classroom? What should be the frequency of feedback, the manner in which information is presented to students and instructors, the data collection mechanisms?
- How can the new technology encourage and monitor group decision making?
- How does the quality of learning compare in this medium versus others?

A second area of programmatic research to be conducted at the University of Maryland is being led by members of its Center for Teaching Excellence. According to the proposal, "Currently, teaching evaluation is typically carried out at the end of a course. Similarly, the largest proportion of the student's grade is determined at the end of a course, when the student has no opportunity to correct the product. This is analogous to inspecting (and then correcting) products after they are completed, rather than building improvements into the original design." The Center, therefore, in its desire to build systems that support continuous improvement by Maryland students and faculty, has generated a teaching/learning research agenda. The university intends to develop new learning outcomes assessment and course assessment approaches and to administer them with an eye toward prevention, while the class is at an early stage in the semester.

Again, these lines of inquiry are directed inward, at improving educational processes within, in this case, the University of Maryland. Certainly the results of such research have broad application to higher education. Other institutions, however, took an opposite approach and pursued more generic questions. The University of Wisconsin-Madison, for example, proposed to study how successful industries have integrated TQM concepts of internal and external customers, teamwork, employee empowerment, and continuous improvement into their cultures, and how these experiences might be transferred to educational settings. The goal is to establish a research base from which to determine the effects of TQM on higher education. The research objectives articulated by UW-Madison are as follows:

- Faculty perceptions of TQM and the extent to which they are introducing TQM principles in their courses and practicing TQM principles in their classrooms
- Faculty perceptions of perceived changes in curricula and classroom teaching as a result of their exposure to TQM principles
- Processes of introducing TQM into curriculum

Finally, it was mentioned that there were a number of exciting research ideas that had a more targeted or narrow focus. All of these ideas emanate directly from the unique circumstances, capabilities, or mission of the various universities. As an example, Oregon State University will pursue research to assist small business with implementation of quality management. The driving force behind this initiative is the unusually high percentage of small businesses in the state of Oregon and the already strong outreach capability of OSU's Small Business Institute and its Oregon Productivity and Technology Center.

The Clark Atlanta University and SouthernTECH collaboration produced a research initiative that illustrates the desire on the part of the institutions to leverage their specific expertise. Clark Atlanta is a historically black university; SouthernTECH, in contrast, has a student population that is almost 80 percent white. One of their five research initiatives will study the impact of the implementation of TQM on diversity issues in the workplace. As the proposal states, this research initiative is based on the hypothesis that the framework of TQM concepts and principles establishes a neutral work environment with respect to diversity issues. The core TQM principles of focusing on processes (not the person), empowerment of employees, teamwork, and so on should begin to eliminate inequities that flow from diversity characteristics. Specifically: "A research instrument will be designed and administered using the Malcolm Baldrige award winners as well as other designated organizations that are perceived to be models of TQM implementation."

Process Management

A process is a series of activities performed to achieve a specific outcome. The process of research, then, is the series of activities that links a problem statement to the generation of knowledge. Several institutions felt that it was important to acknowledge and describe the way in which their research topics were developed and the activities that needed to be completed.

A general framework was offered by the Georgia Institute of Technology. Its proposal states the intention to develop a scientific understanding of what works in TQM, why it works, and what might work even better. The "what works" topic is basic theory. "How it works" requires research directed at effective use of TQM principles in specific industries or application fields. "How to do it better" extends the research into experimental designs that test various methods.

The University of Wisconsin-Madison described another research planning process. Its five-part process begins with a step to sharpen the proposed research focus in alignment with inputs from the university's National Research Council. The second step is to conduct the research. The third step is to develop and test implementation methods for the new knowledge that results from the core research. The next step is to revise the research based on learning from the implementation into the initial organizations and to publish the results so that

they become known to appropriate industries. The final step is to establish outreach programs and curricula implementation plans and to develop new credit courses or modules that can be integrated into the appropriate core courses.

The most comprehensive process orientation was outlined by the Rochester Institute of Technology. It first detailed a matrix that evaluated research projects against a set of project criteria. In the College of Business, for example, eight projects — including software quality assurance strategies and customer satisfaction measures — were enumerated and assessed via the matrix. Below is the analysis performed for a project entitled "Analytical Hierarchy Process Applications to the Quality Function Deployment Process":

Project Criteria Matrix

Project	Objectives	Faculty Interest and Expertise	RIT Facilities	Relevence to Industry and Education	Relevence to Core Courses
AHP Applications to QFD	Using AHP process results as input into the QFD process	Two faculty members are doing intitial work in area	N/A	An industry partner is working in this area	This topic fits into both Mgt. Sci. and Opers. Mgt. courses

RIT also has developed a process that enables it to track the status of project activities using a standardized series of checkpoints. There are eight: (1) identification of research projects, (2) formulation of focus teams, (3) literature search/industrial benchmark, (4) refinement of proposed research effort with focus team and industrial partner, if appropriate, (5) development

of experimental design methodology, (6) implementation, (7) analysis of results, and (8) presentation of results. As an illustration, the Analytical Hierarchy Process project currently stands at:

Project Checkpoints

	1	2	3	4	5	6	7	8
AHP Applications to QFD Process	C	O	O	F	F	F	F	F

Key: C = Step completed O = Ongoing activity F = Future activity

Partnerships

It is important to note that all the proposed research initiatives mentioned collaboration. The general orientation was to use advisory boards to cultivate industry ideas and to facilitate the "partnering" of professors and industry professionals. A number of specific partnerships were described. For example, Oregon State University's School of Business is working with Santa Teresa Labs, in San Jose, California — a software supplier to IBM — to make software development teams more effective.

Of all the IBM-TQM institutions, the University of Houston-Clear Lake might be the one with the most intensive orientation toward building partnerships. Indeed, UHCL has been nation-

ally recognized as a leader in building partnership initiatives. It has made the UHCL Enterprise Model a dynamic and successful institutional operating paradigm. *(See Exhibit 3.)*

The institution is located adjacent to the National Aeronautics and Space Administration's Johnson Space Center (NASA/JSC) and IBM's Federal Systems Company. In 1986, NASA/JSC and UHCL founded the Research Institute for Computing and Information Systems (RICIS) to pursue joint research and educational activities. The institute includes a network of universities, research institutes, and private industries. (IBM is a seatholder on RICIS's Technical Advisory Board and a member of RICIS's Industrial Affiliate Program.) RICIS efforts in quality have evolved in step with the efforts of area government and industry. For the past three years, for instance, RICIS has focused on incorporating modern quality engineering practices into the emerging discipline of software engineering. Future research initiatives that involve TQM principles and practices will be a natural outgrowth of this and other partnership arrangements at UHCL. ■

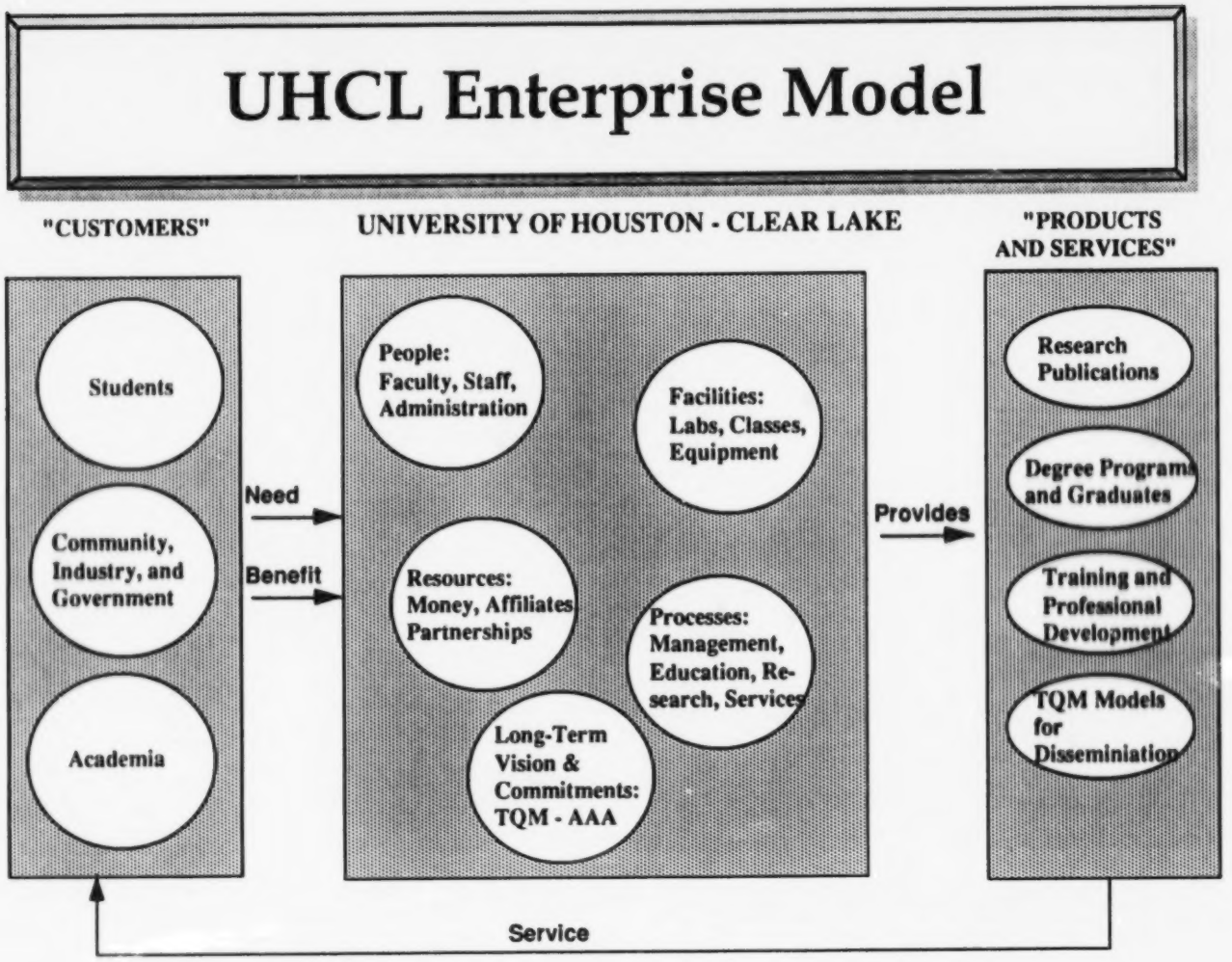


Exhibit 3. *UHCL Enterprise Model*

Chapter 4

Running the University

In the previous section, the word that symbolized the ideas and actions of the institutions was "leverage." The universities looked to their research initiatives as a way to strengthen their relationships with industry (i.e., to respond to customer needs) *and* improve their curriculum.

The IBM-TQM Partnership was structured to reflect IBM's interest not only in teaching of TQM principles and doing research on TQM practices, but in promoting the use of TQM as an operating system. And the word that emerged from the proposals that seemed to characterize the feelings of the investigators and officials was "commitment." For example, Pat Crecine, Georgia Tech's president, stated, "Georgia Tech, as a community, is going to make the long and difficult journey down the TQM path to continuously exceeding our customers' expectations. I am personally committed to providing the constant leadership and support necessary to make this journey a successful one." John Brighton, Penn State's provost, said in his opening letter to IBM, "I have made a personal commitment for implementation of TQM at Penn State." Other presidents, provosts, deans, and principal investigators made similar statements that reflected their willingness, at some professional risk, to lead their institutions through uncharted waters.

This section of the Report, "Running the University," comprises three parts: Implementation Plans, Infrastructure, and Teaching and Learning. The initial part discusses the major strategies that the institutions have adopted to implement TQM in their operations. The second part details organizational structure issues. Finally, stimulated by IBM's suggestion in the competition guidelines that one of the areas universities might want to explore is "classroom instruction," a number of such teaching and learning initiatives emerged, and they are described here.

Implementation plans

One of the implementation strategies that emerged from the proposals involved an overt attempt to link TQM with other institutional operations. This "linking" strategy has the distinct advantage of giving TQM an organizational anchor point, something for it to "grab on to." At Georgia Tech, that anchor point is strategic planning. Indeed, a key strategic objective is, "Integrate the Institute's TQM effort with the strategic planning process and the institute-wide compensation and classification study." At the University of Houston-Clear Lake, the anchor is a new shared governance process, called Advancing Academic Achievement (AAA). Through it, UHCL is striving to become a responsive regional university that has a clear mission and a shared understanding of the processes and procedures used to achieve established goals. The concepts of TQM are embedded in the language and the reshaping activities that are the foundation of the AAA operating paradigm.

Another implementation strategy is to create a stand-alone, comprehensive blueprint for action. This strategy involves a detailed series of steps that are designed to *transform* a culture, in contrast to a "linking" strategy's attempt to *reshape* a culture. One example of such a "blueprint" strategy is the University of Maryland's Continuous Improvement Plan. Submitted to President Kirwan in December of 1991 by the Continuous Improvement Planning Committee, the plan provides a rationale, an implementation approach, and a proposed organization and resource plan. It also sets out a series of guiding principles:

- The decentralized organizational structure of UMCP will be preserved in implementing continuous improvement. Each division will adapt the continuous improvement approach to fit its needs
- From the beginning, continuous improvement will be implemented in academic as well as non-academic functions
- Within each division, to the extent feasible, implementation of continuous improvement will be initiated by units themselves rather than dictated by senior administration
- At the same time, institutional leadership, rewards, and resources will be aligned to encourage broad participation in this effort and to recognize and support those individuals and departments who learn and use continuous improvement processes
- Continuous improvement will be unfolded incrementally across campus. In each division, only some units will begin implementing continuous improvement immediately, followed by a few more some months later, and so on

University of Houston - Clear Lake

The University of Houston-Clear Lake is an upper-level and master's degree institution within the University of Houston system. The campus, with 7,500 students and more than 175 full-time faculty members, is adjacent to the Johnson Space Center, one of NASA's largest research and development facilities. The community surrounding UHCL is among the most highly educated in the southwestern United States; more than 15,000 engineers are located in the area.

The IBM-TQM competition proposal offered by UHCL had numerous strengths: a powerful Enterprise Model that fosters community relations and industrial partnerships, a history of TQM-related coursework on which to build, and a commitment to integrate TQM into the academic environment. The integration strategy, Advancing Academic Achievement (AAA), is an approach to improving every aspect of university operations to better serve its customers — students, faculty, and community.

But these considerable strengths, these pillars of innovation, rest on a foundation of trust. In an opening letter, President Glenn Goerke made the statement, "Our university has learned that transforming to a quality-based model is a difficult, soul-searching process that often is at odds with traditional academic culture." Certainly most people understand that the TQM operating paradigm is a cultural transformation. Continuous improvement is collective mindset. Breaking down organizational barriers fosters an environment that values horizontal communications. Encouraging the gathering

Given these guiding principles, the plan goes on to detail an approach for creating awareness: "... the committee is convinced of the need to involve all members of the campus community in understanding the many ways in which they can, and should, contribute towards the quality goals of UMCP." It also enumerates a series of awareness training initiatives. Unit training in continuous improvement is part of the "blueprint." The plan calls for the entire unit (staff, administrators, and/or faculty) to participate in a comprehensive half- to two-day unit training program. Each division could adapt the training approach and length to suit its needs. The training is to be facilitated by a professional facilitator, and the unit head will take a visible and active role in the training. As part of the training, units will:

- Identify their outputs in relation to the UMCP mission
- Identify their customer(s)
- Clarify the process they will use to identify and prioritize their customers' requirements
- Clarify the process they will use to modify their unit service delivery procedures and outputs so as to achieve their customers' requirements
- Select measures to monitor their effectiveness in meeting customer requirements
- Develop data collection strategies

of data and use of statistical analysis creates a more rigorous and analytical approach to problem solving. It is reshaping culture.

The "difficult, soul-searching process" that President Goerke referred to is really a process of building trust. Trust comes first, then the changes. This became apparent in remarks made by Glenn Freedman, UHCL's associate vice president, at the IBM Sharing Conference. At one point in his presentation, Freedman said, "I'll give the president credit, the first thing he did was to open our budget. The entire budget is available to anyone on our campus who wants to see it — it's on-line. The level of trust that simple move made was amazing."

At another point, Freedman stated,

"We have completely transformed the way we go about doing business from ninety-some random committees to five governance committees. It was a leap of trust to include all our stockholders — students, faculty, administration, professional and support staff, and, where appropriate, community members — in this new shared governance model."

Being only twenty years old has its advantages. UHCL uses a boundary-spanning approach influenced by NASA and other community partners. It relies on solid leadership who realize that if quality is to improve in all aspects of organization, "what's in it for me" must be replaced by "what's in it for us"; data for accountability needs to be replaced by data for improvement; and trust and a commitment to quality education should drive it all.

Within these areas, a number of processes have been targeted for improvement. For example, "improve cycle time in the Office of Financial Aid" is a planned effort in academic affairs. In administrative affairs, it is "improve billing statements and responses to customer complaints" and "reduce delay rates for accounts payable process." In student affairs, "retention of transfer students," and in institutional advancement, the need is to "improve the cycle time for depositing private gifts." Maryland's plan also contains specific efforts to communicate results, measure progress, and revise reward and recognition policies.

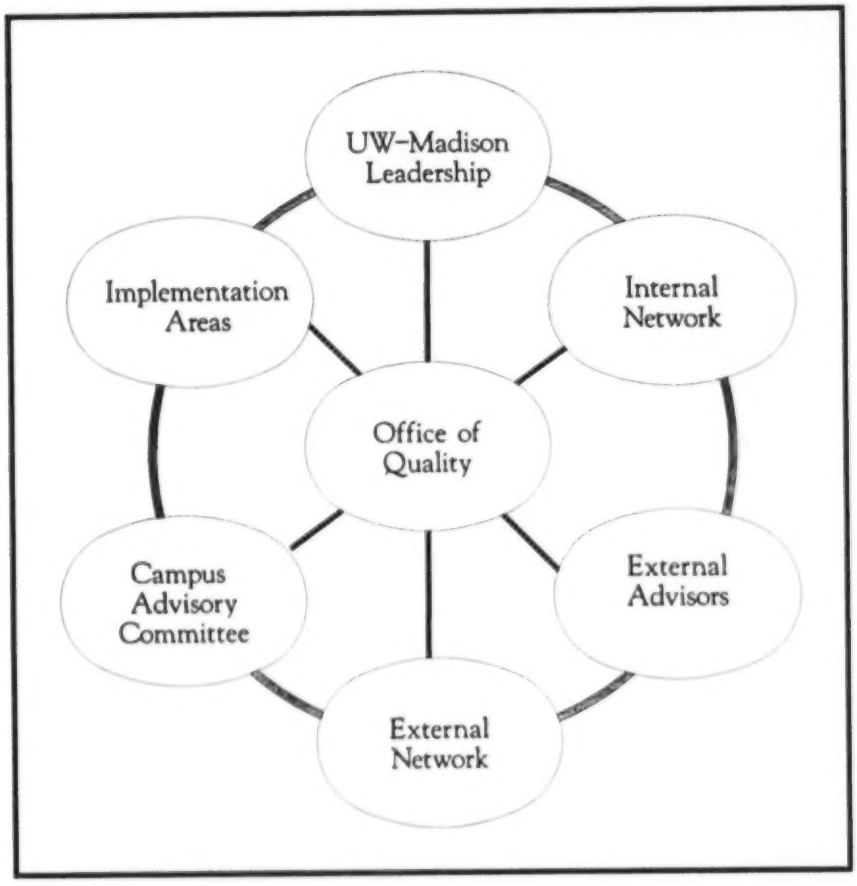
SouthernTECH also has chosen a total organizational approach, or "blueprint" strategy, for implementing TQM. Its nine-phase strategy involves (1) orientation and awareness, (2) culture assessment, (3) design of infrastructure, (4) training of the "critical mass" in TQM, (5) determination of customer requirements, (6) quality planning, (7) quality function deployment, (8) monitoring and measurement, and (9) implementation of the Plan-Do-Check-Act cycle.

Two additional institutions in the IBM-TQM Partnership have pursued a comprehensive approach to implementing TQM in their campus operations. Oregon State University is furthest along in its efforts. In 1990, OSU put together a five-year implementation plan for the administrative side of the university. Three-day TQM training sessions were developed by OSU's Department of Human Resources. Now, three years later, there is a track record of teams that have improved a broad array of processes: space inventory, workers' compensation, billing/accounting, graduate admissions, and so on. According to the proposal, "Currently, we have 75 teams operating in all areas of administration. We have begun TQM pilot programs in six colleges and have expanded into the Library, Extension Service, and other units. We plan to expand the number of teams to 150 by December 1993."

There is one aspect of implementation that OSU has taken a special interest in — the recognition of the efforts of TQM teams and the celebration of their accomplishments. According to Oregon State, "We want to give teams an opportunity to share their quality accomplishments with one another and with the university community in a celebrative atmosphere." The result is an annual Quality Fair, at which teams construct displays to explain their activities and results to the campus community.

If OSU has progressed the furthest in terms of implementation, perhaps UW-Madison has the most systematic approach. Its "System for the Implementation of Quality" suggests that changing the culture of a campus requires a support system — both internal and external — that will provide the leadership, incentives, resources, and planning to effect change. *(See Exhibit 4.)*

Exhibit 4. *UW - Madison's System for the Implementation of Quality*



Several administrative and operational areas on the UW-Madison campus are leading comprehensive efforts to implement TQM concepts. They include Admissions, the Registrar's Office, Graduate School of Admissions, Dean of Students Office, Housing, Purchasing, Physical Plant, Student Financial Services, and Police and Security. The administrative offices of Business and Engineering will begin TQM training so they can apply the concepts to processes such as advising, class scheduling, financial support systems, purchasing, and faculty recruiting.

Each implementation area begins with the leadership team going through education and an initial planning process. The planning process includes identifying customers and their needs, developing mission and vision statements, enumerating critical processes, describing the current situation, choosing a problem for improvement, and generating a plan of action.

The final implementation approach might be called a "unit" strategy. A unit strategy involves little, if any, institution-wide planning; that is, there is no "blueprint." It also is not "linked" to a cross-functional process or system such as shared governance or strategic planning. At Rochester Institute of Technology, the divisions of Finance and Administration and

University of Maryland - College Park

The University of Maryland-College Park (UMCP) is the land-grant and flagship campus for the eleven universities and four research centers of the University of Maryland system. With more than 100 undergraduate and more than eighty graduate degree programs, UMCP offers its 35,000 students a comprehensive portfolio of academic options.

The quality movement has a long history at Maryland. For the past thirteen years, the university's Center for Quality and Productivity has been involved in assisting Maryland companies understand and implement the concepts of TQM. But the unique strength of Maryland's IBM-TQM proposal is not a function of institutional experience but rather in its leadership's ability to articulate a compelling vision for change. The tone was set from the beginning. In his cover letter to IBM, President William Kirwan said,

"I am convinced that universities must fundamentally alter their educational strategy and institutional infrastructure in order to meet the challenges of the global marketplace in the twenty-first century.... The initiatives discussed in the proposal are designed to achieve a profound change in the culture of the institution, and in the educational product we deliver to our customers."

The president's words reflect a commitment to a long-term perspective and a sense of purpose. The unifying goal is to deliver an educational product that will meet the competitive challenges of the twenty-first century — in other words, W. Edwards Deming's notion of "constancy of purpose." As Deming suggests, there has to be a framework within which managers can operate, otherwise they can only respond to crises. Unifying goals help an organization through difficult times by providing that sense of purpose.

Maryland acknowledges two major pressures in the 1990s that forced the university to rethink its operating philosophy: cost containment and

Enrollment Management and Career Services have initiated customer-driven improvement efforts. Clark Atlanta University has chosen to pilot the implementation within a specific department. While Penn State has made a "commitment to implement TQM across the university," its colleges of Engineering and Business have been the pioneering units. The College of Engineering has identified five principal areas for potential TQM application: faculty recruiting, graduate student recruiting, strategic planning, research administration, and undergraduate instruction. In each of these areas, process owners, facilitators, and team members have been identified. The College of Business has begun introduction of TQM into the operations of its Undergraduate Programs Office.

Infrastructure

A number of general, organizational design features are common to most of the projects of the nine Partnership institutions. First, they have established, or are going to establish, a continuous improvement capacity, either as a stand-alone office or within another institutional unit. Second, these offices report to the president or to the head of human resources. Finally, there is usually a university-wide council, chaired by the president and supported by the continuous improvement office.

accountability. The extreme financial problems facing the state of Maryland have caused a dramatic cut in state support. Also, the Maryland Higher Education Commission, following directives from the legislature, has mandated that all state-supported higher education institutions provide an annual accountability report.

Throughout the proposal, the principal investigators projected a sense of purpose. For example, "With no prospect of a quick turnaround, it is imperative to get more from existing resources." Or this statement: "There are also increasing pressures to demonstrate value-added as a justification for tuition increases and for taxpayer investment in the university. This means that universities must become more adept at assessing their contributions to the lives of their students and to the communities that surround and support them."

This driving force, this constancy of purpose, was perhaps best summarized by another member of the UMCP community. Judy Olian, a business professor and principal investigator of the IBM-TQM project, said at the IBM-TQM Sharing Conference,

"We recognize that the universities of the year 2000 that will be successful will look substantially different from the universities of the 1980s and early '90s. If we want to be among those that are successful, we have to change. We have to change in relatively dramatic ways, and in that sense we view TQM as a process of cultural transformation."

The continuous improvement offices vary somewhat in form and function. At the University of Wisconsin-Madison, the office is called the "Office of Quality Improvement," and its mission is "to plan, guide, and facilitate the design and improvement of systems throughout the UW-Madison campus so that the University may exceed the expectations of its customers." It serves as an internal consultant, reports to the chancellor, and has a very tightly focused mission. The Pennsylvania State University has taken a similar approach. Its "Continuous Quality Improvement Office" works to assist faculty and staff in the implementation of TQM across the university. Further, "the director and staff will plan and conduct education and training programs, assist in the identification of critical processes and the appointment of teams, serve as consultants to teams, and monitor and disseminate the results of team activities."

At Georgia Tech, however, the office is called the "Office for Continuous Improvement and Assessment." It provides staff and technical support to the president and the institution's quality council. But it also has responsibility for coordinating the assessment and accreditation reports required by the Board of Regents and the Southern Association of Colleges and Schools. The University of Maryland also has designed an office, within the President's Office, that has both an internal and external focus. In this instance, it is facilitating the diffusion of TQM on campus and filing "accountability reports" to the Maryland Higher Education Commission:

> *Office of Continuous Improvement and Accountability* — The President will appoint a senior individual as the staff person supporting: (a) the President's continuous improvement activities; (b) the work of the CI Council; (c) coordination of the accountability report for delivery to the Higher Education Commission; and (d) campus units' continuous improvement activities. The latter responsibility includes providing units with facilitation assistance in continuous improvement training and implementation, development of continuous improvement training materials, administration of the campus continuous improvement reward and recognition program, and development and implementation of a strategy to communicate news regarding continuous improvement.

Additionally, it should be noted that the continuous improvement function can reside within existing organizational units. The Rochester Institute of Technology has a quality council within the Office of Training and Professional Development. Its role has been largely focused on training. Until very recently, Oregon State University's quality management program was the responsibility of its director of human resources. Now the program reports directly to OSU president John Byrne.

At most institutions there is a high-level quality council or steering committee. In every instance, the council is chaired by the campus CEO — president, chancellor, or provost. These councils include vice presidents, deans, professors, and so on. The University of Maryland has the most "representative" composition: "... the Council is comprised of the Vice Presidents, and (a) representative(s) from the following groups: faculty, associate staff, classified staff, students, and alumni."

And what do they do? The Maryland council is charged with "... establishing quality improvement priorities, policy, and reward and recognition strategies. The Council will review quality improvement data and issue an annual Continuous Improvement Progress Report." Georgia Tech's council has a similar role to play: "The Council will advise the president on the development of the Institute TQM strategy, which implements the priorities established in the Institute strategic plan, and issue an annual Institute Continuous Improvement Progress Report."

Teaching and Learning

This final part involves the core critical process in a college or university — teaching and learning. Curriculum development entails "what" we teach. Classroom instruction, in contrast, is at the very heart of "how" we teach.

The application of TQM principles and concepts to teaching and learning is a difficult issue for higher education. The problem is best illustrated by the statement made in Oregon State University's proposal:

> *"The President and vice presidents became enthusiastic about the potential of TQM; however, we face some skepticism on the academic side. Although some members of the academic community began to give qualified approval to TQM, we realized that one of the big questions was, 'Will TQM work in the academic arena?' ... We decided we must show success on the administrative side before we could introduce TQM on the academic side beyond encouraging the teaching of TQM classes to students in engineering and business."*

The belief that faculty members will forcefully resist any coordinated effort to change has resulted in most higher education institutions choosing to avoid the battle.

There were several important exceptions. Georgia Tech noted as part of its TQM curriculum development the hope to challenge many of the conventional classroom instruction assumptions. For example, "we need to examine (1) the impact of alternative evaluation and grading procedures, (2) the timing of material introduction, and (3) alternative delivery methods which explicitly recognize that different people learn in different ways."

A more systematic effort was offered by the University of Maryland. After detailing plans to introduce a sequence of four core courses, the proposal went on to suggest that a new teaching strategy should be examined:

> *"We will build TQ features into the teaching methodology, including customer design of courses, team teaching (faculty, business partners, and consumers), real-time data and feedback, cross-functional student project teams, module-based courses from which students and employers can make need-based selection decisions, organizational projects, and process and outcome evaluation of accomplishments by employers, students, and faculty."*

Maryland wants to test these ideas in this four-course sequence and build from that a curricular approach that will affect all engineering and business students in the years to come.

University of Wisconsin - Madison

The University of Wisconsin-Madison has a TQM history. In 1990-91, UW-Madison initiated interdisciplinary graduate concentrations in Total Quality sponsored by the School of Business, the Department of Industrial Engineering in the College of Engineering, and the Department of Statistics in the College of Letters and Science. UW-Madison also has a distinguished record of research that has directly impacted quality in industry worldwide. Much of this success is due to Professor Emeritus George Box, who founded the Department of Statistics in 1960 and co-founded the Center for Quality and Productivity Improvement in 1985.

Still, the distinctive aspect of the University of Wisconsin-Madison's effort in the IBM-TQM competition had less to do with experience than adherence to a key quality concept — being customer-driven. The first hint came in the opening paragraph of the cover letter signed by the then-chancellor, Donna Shalala, and the deans of the College of Engineering and the School of Business: "We applaud IBM's initiative and are delighted with this opportunity to highlight our commitment to meet and exceed the needs and expectations of our key customers — students and their future employers — through a TQM focus in our Business and Engineering curricula."

The key elements of the competition — curriculum, research, and operations — are major aspects of life on a college or university campus. In submitting a proposal, it would have been easy to forget to practice the principles in one's own work. For example, generating a list of courses that would include TQM concepts is not difficult. What is difficult is to apply those very same

UW-Madison plans to extend research on the application of quality improvement strategies to teaching and learning. An initial effort piloted in an undergraduate business statistics course met with great success. According to the proposal, "Dramatic improvements were achieved in effectiveness." The proposed research carries that work further, to help both identify obstacles to learning and determine whether TQM can make a difference in terms of student understanding and retention, course evaluation, grades, and attendance.

Perhaps the most ambitious plans to apply TQM to instructional processes is being made by the Pennsylvania State University, which proposes to establish a team of master teachers from business and engineering. In year one of this initiative, the team will assess the role of TQM in instruction and develop a plan for facilitating the application of TQM by departments. The team also will develop measures for evaluation. In year two, departmental teams will be established to develop plans for implementing TQM methods to improve learning in their courses. These techniques will be pilot-tested in years three and four. The master teacher team will disseminate its results widely across the university and also, through participation in academic conferences, will share the results with colleagues at other universities. ■

concepts to the curriculum development process. UW-Madison showed that it knows and practices a customer orientation.

Here are several illustrations. The curriculum section of its proposal noted that a new honors program is in the early design stages. But rather than just detail the content and scope of the program, the description centered on process. In this case, the process of using quality function deployment (QFD), a TQM method, to carry the voice of the customer throughout each stage of product development: "... we are using a QFD approach where the needs of the customer (students, employers, faculty, parents, etc.) are being determined along with the mechanisms to satisfy these needs."

In the area of research, the proposal enumerates general topics — e.g., cross-functional management, new product and service development. But again, rather than merely detailing UW-Madison's research agenda, the process of engaging in active customer "listening" is described: "IBM will be a valuable resource in this partnership. We would like IBM to cooperate in all steps of this research plan. During step one we would involve IBM as a key customer in prioritizing the research topics. We will also seek input from other industries and from the Quality Forum committee on industry needs."

Finally, the Office of Quality Improvement, located in the Chancellor's Office, uses a scheme entitled "Initial Planning Process" to aid individual areas of the university in their efforts to apply TQM principles to their work. At the top of the chart in big, bold letters is the word "customer" followed by two questions: Who is impacted by our work? What are their needs?

Chapter 5

Propagation and Sharing

One of the most challenging aspects of the IBM-TQM Partnership was the issue of propagation and sharing. In the competition, institutions were asked to describe the process by which they plan to propagate/share research findings and TQM integration plans with other colleges and universities. The challenge stems from the fact that higher education suffers from a well-entrenched "not invented here" syndrome. Members of colleges and university communities tend to think of themselves, and their institutions, in idiosyncratic terms — they are special. As a result, innovations often do not readily diffuse through our institutions. "Best practices" often do not disseminate beyond the campus walls.

The Partnership institutions are well aware of the problems and opportunities. As an example, the Georgia Tech proposal noted, "We fully recognize that a transformation to TQM in higher education in this country is needed, and will not happen without cooperation and sharing of the best ideas and implementations among schools, business, and industry." A review of the propagation and sharing plans proposed by the Partnership institutions reveals a broad array of ideas. The following seem to have the greatest potential impact:

Newsletters: Targeted to education and/or industry

Regional forums: Colleges and universities within a region would meet regularly to discuss TQM implementation in the higher education environment

Electronic bulletin boards: Quality development activities would be posted to an electronic bulletin board

Resource libraries: Such libraries would contain house books, periodicals, research papers, training resources (manuals, videos, computer-based training materials), software, and electronic access to research databases

Modules: Development and packaging of curriculum to be used by other colleges and universities

Meeting presentations: Papers and workshops presented at professional meetings would help diffuse ideas through disciplines and association memberships

Journals/articles: Manuscripts would be submitted for review (and publication) in scholarly journals

Press releases: A conscious effort to tell the "quality story" through local, regional, and national media

Education and training: Campus-based education and training programs (typically attached to offices of human resources, continuing education, or quality improvement) that would be available to the broader higher education community

Centers and institutes: Relevant boundary-spanning centers and institutes would be used to facilitate information flow to external constituencies

As a final note, it should be mentioned that the IBM Sharing Conference held in February 1992 produced an agreement that the Partnership should attempt to generate a coordinated propagation and sharing strategy in addition to these individual efforts. The purpose of the coordinated strategy would be to document and disseminate "best practices" and "lessons learned" that emerge from the universities over the course of the Partnership. The form of that strategic endeavor will be decided at the next Sharing Conference, scheduled for October 1993. ■

Appendix

Appendix

An IBM - Total Quality Management (TQM) Competition for Colleges and Universities

Guidelines

1. Background

This program recognizes the vital importance of Total Quality Management for the success of our businesses, educational institutions, and governmental agencies.

Total Quality Management is a management system which provides for the unyielding and continually improving effort by everyone in an organization to understand, meet, and exceed the expectations of the customer.

There is significant work to be done to better understand, codify, and implement Total Quality Management principles. It is our hope the colleges and universities participating in this program will make a major contribution to this work.

2. Purpose

To encourage colleges and universities to do work in the following:

a) In integrating TQM concepts into graduate, undergraduate, and executive core courses in business and engineering programs
b) To develop a faculty research program in TQM
c) To apply TQM to the operation of the institution itself and to propagate TQM to other colleges and universities

3. Scope

IBM will make eight awards in the U.S.A., each consisting of $1 million in cash or $3 million in IBM equipment (or a combination thereof, with equipment counted 3:1 to cash) over five years.

Award-winning institutions will have the opportunity to enter into a partnership with an IBM area/plant site. The IBM partnership may consist of one or more of the following elements:

a) Loaned executive(s)
b) IBM speakers
c) Faculty and student internships with IBM
d) Classes on IBM's approach to market-driven quality
e) Cooperation on research
f) Participation in a network of TQM companies, colleges, and universities to share information, research, "best practices," and so on

4. Proposal Submission

Elements which will be considered in evaluating a proposal are:

a) Curriculum Development — this includes undergraduate, graduate, and executive education courses in which TQM concepts will be imbedded. At a minimum, these should include core sources in the institution's business and engineering curricula with emphasis on interdisciplinary cross-functional integration of business and engineering curricula. The proposal should outline the steps to be taken to determine TQM curriculum content and the plan for curriculum change and implementation. A comparison, detailing existing curricula with planned curricula, is requested. A brief statement of your institution's objective in making these changes is required. We are interested in the earliest implementation possible of the changes. For this reason, we request a timetable for changes. We realize this may necessitate use of case studies prior to developing a theoretical basis from research for these changes. [40]

b) Research — the research on quality planned by your institution. Outline your objectives and work plan to achieve your goals. Explain why you selected your topics and how they relate to core courses. Please highlight any dependencies you have on IBM to achieve your goals (e.g., collaboration with an IBM area/plant site). Specify completion date and estimate checkpoints for validating progress. [15]

c) Running the University — the activities planned in implementing TQM concepts in the administration and operations of the institution, which could include finance, physical plant, admissions, classroom instruction, research administration, and so on. Outline your objectives with timetables to achieve improvements in customer satisfaction. [10]

d) Vitae — a brief background on each member of the institution's faculty and administration involved in the above should be provided, with particular emphasis on TQM. [5]

e) Institutional Commitment — the institution's commitment of funding and personnel dedicated to these programs, including a waiver of indirect cost charges. [10]

f) Additional Support — additional public and private support to be committed or sought for these activities, including the magnitude of the financial and personnel support. [5]

g) Evaluation — the evaluation and measurement processes that will be used to assess the success of these endeavors. [5]

h) Propagation/Sharing — the process by which you plan to propagate/share research findings and TQM integration plans with other colleges and universities. [10]

The judging weight for each of the above is indicated in brackets. Since industry is particularly interested in student and executive graduates with an education and understanding of TQM, the course content will be the major focus of judging, although the other components are also important in an overall assessment of the institution's commitment to TQM.

Please tell us how the IBM support will be utilized, including key milestones or checkpoints. It is anticipated that the cash support will be divided equally over five years, with the award for years three, four, and five dependent upon the progress in the years one and two compared with the institution's award-winning proposal.

The proposal should be concise. A maximum length of 25-30 pages exclusive of charts or graphs is recommended. The deadline is May 1, 1992. All proposals will be reviewed by IBM professionals. Responsibility for proposal review and evaluation rests with the IBM Corporation.

➢ Selection Process

IBM received 204 completed proposals by the May 1, 1992, deadline. Applications were submitted by schools of every size, academic specialty, and geographic location in the United States. They included individual schools and groups of schools, such as "consortia" linking universities, community colleges, and K-12 school systems.

Some sixty IBM examiners, trained in the Malcolm Baldrige National Quality Award process, spent nine days evaluating the applications. The examiners were grouped into fourteen teams, each led by a senior examiner. Teams were screened to ensure that members were not affiliated with any school whose application they would be examining.

Scoring guidelines were provided to help the teams. Team members scored each application individually, then the team reached consensus on a common score. Senior examiners randomly reviewed applications and scores to ensure consistency. Statistical analysis was used to determine if any teams were scoring significantly higher or lower than their peers.

Following this process, the senior examiners presented the top twenty-five applications to a panel of judges made up of IBM executives experienced with TQM and the Baldrige Award process. All information that could enable the judges to identify a school had been deleted from the material they reviewed, and each school had been assigned a confidential number. The panel recommended the final recipients to an IBM Senior Executive Steering Committee and, finally, to IBM chairman John F. Akers, who granted final approval. ■